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Country v sector effects in equity returns: Are emerging-market firms just small firms?

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Country *v* Sector Effects in Equity Returns: Are Emerging-Market Firms just Small Firms?*

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Abstract

In the debate whether country factors are typically more variable than sector factors, sparked off by e.g. Roll (1991) and Heston and Rouwenhorst (1994), one of the few uncontested facts is that the addition of emerging markets (EMs) does boost the ratio of country-factor variance relative to industry-factor variance. Emerging markets do tend to have a higher variability but simultaneously are less related to global market and industry factors. We investigate to what extent this phenomenon can be traced to the impact of adding more small firms. We find, first, that small firms do have higher volatility, but one needs to control for country and sector affiliation before that becomes visible. We next find that small firms do have weaker sector affinity, as expected. Third, small firms unexpectedly have weaker local-market sensitivities than large firms. Facts 2 and 3 mean that adding more small firms to the data base has a diversifying effect on both the sector- and country-factor variance; and while the impact on sector variance is larger, the net effect turns out to be tiny. Fourth, adding emerging markets has a very marked impact on the variance ratio. In fact, the addition of small stocks to the sample hardly dents the effect of adding EMs. Thus, the role of emerging markets cannot be reduced to just a small-firm phenomenon.

JEL classification: G11, G12, G15.
Key words: international stock returns, world, country, sector, small firms, diversification

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Introduction

In a seminal study, Heston and Rouwenhorst (1994) find that, among the factors behind international stock returns, country factors are typically more variable than sector factors, or surely were so in the 1970s and -80s. This article sparked off a lively literature. According to some, the importance of countries has waned in the 1990s (Hardouvelis et al., 2006; Emiris, 2002; Campa and Fernandes, 2006; Carrieri, Errunza and Sarkissian, 2003; Isakov and Sonney, 2004; Baca *et al.*, 2000; Cavaglia *et al.*, 2000; Galati and Tsatsronis, 2003). But other studies disagree (Sentana, 2002; Rouwenhorst, 1999; Brooks and Del Negro, 2005; Gerard, Hillion and De Roon, 2003).[1] Part of the contradictions in these findings stem from different methodologies, but much of the blame must be due to differences in data selection, especially the range of countries and the level of the sector aggregation. In fact, not all of these studies answer the same question: country factors might very well have become secondary within Euroland of the EU, for instance, but may still be the prime source of uncertainty if also emerging markets (EMs) are brought into the sample.

One uncontested fact indeed is that the addition of EMs does boost the ratio of country-related variance relative to industry-related variance. The reason is that these emerging markets tend to have a higher variability but simultaneously are less related to global market and industry factors. What struck us is that these properties also apply to small firms. Small-caps tend to be overlooked in this literature.[2] But while large-cap portfolios by country are well spanned by a world factor and foreign large-cap factors or exchange rates, the small-cap sections of the national markets seem to behave rather idiosyncratically relative to global market and industry influences, see Eun, Huang, and Lai (2003). Thus, adding small caps to a data base should have a diversifying effect on the global-sector factors. Eun *et al.* do not study the

[1] Related relevant work includes Beckers et al., 1996; Brooks and Del Negro, 2006; Forbes and Chinn, 2004; and Griffin and Karolyi, 1998; Methodologically less comparable work includes Beckers et al., 1992; Brookes, M., 2000; Ehling, P. and S. B. Ramos, 2006; Ramos, 2003; Roll, 1992; and Sharaiha et al., 2003, 2004.

[2] Small-caps are not covered by Thomson Datastream's (TDS) market lists, the dominant source of international data, and researchers often prefer not to waste time on penny stocks and are not eager to clean up TDS's untidy "research" or "dead stocks" files (see Ince and Porter, 2006, for more about TDS data problems).

strength of the small-caps' affiliation with the local market index, but the literature contains some hints. For instance, the higher the number of analysts that follow a particular stock, the lower its market sensitivity, and analyst following is of course related to size (Pearson, 1991; Bushan, 1989; Brennan *et al.i,k*, 1991). Fama (1976) shows how already in the sixties large firms had lower betas and market-model R^2s than small stocks. An additional hint that financial maturity lowers market sensitivity is found in the fact that Fama's pre-WW2 market-model R^2s were much higher than later numbers. Thus, adding small stocks with, probably, a high local-market sensitivity should strengthen the local market factor rather than have a diversifying effect. By strengthening the country-factor variability while weakening the sector influences, the addition of small stocks would then have the same effect as adding emerging markets to a data base. In fact, since emerging-market stocks tend to be smaller, the size effect might seriously weaken the emerging-market effect. All these considerations got us started on the following questions:

1. Do smaller stocks exhibit larger variability than large firms?
2. Are small firms less exposed to global sector influences?
3. Are small firms more exposed to local market influences?
4. Does the addition of small firms weaken or even subsume the emerging-market effect on ratio of market variance over sector variance?

While these issues, except for the last one, seemed largely open-and-shut, the empirical work did provide some surprises. Within each country, for instance, the bottom-quintile stocks are not at all systematically more volatile than the top-quintile companies; only after accounting for both country and sector affiliation does a small-firm effect on variance surface. Small stocks are indeed less exposed to global-industry influences, but they are, unexpectedly, less sensitive to the local-market factor too. As a result, adding small stocks into the sample has a diversifying effect not only on the industry factors but also on the country factors. On balance, the ratio of country variance versus industry variance does drop when the bottom-quintile market-caps are added, but minimally so. Lastly, the size effect by no means subsumes emerging-market effect, even with equally-weighted stocks; in fact, the addition of small stocks hardly dents the EM effect.

We select data for the period 1980-1999 for comparability with most studies, so our intent is not to provide the latest update on the country versus industry issue. Still, we do walk the extra mile and add robustness checks for the other test-design choices that were made by others.

(While similar robustness test have been done before, they were never all applied on consistently the same wide data base, a fact that may explain the sometimes contradictory claims found in the literature.) For that period, we find that country risk is always substantially bigger than sector risk—regardless of country coverage (G7, OECD, or OECD+EM), industry-level specification (SIC level 3 or level 4), weighting scheme (value-weighting the stocks, equally weighting the stocks, equally weighting the country-industry intersection portfolios), sub-periods, and size coverage.

The paper is organized as follows. Section 1 describes our data. Section 2 reviews the Heston and Rouwenhorst (1994) methodology. In Section 3 we look at the small caps' return properties: volatility, global industry sensitivity, and local market sensitivity. In Section 4 we verify the net effect of adding small stocks into a HR study: we apply HR in a base-case sample, and explore robustness to size coverage and country coverage. Section 5 concludes.

1 The Dataset

Our aim is to create an equity database that offers maximal coverage within and across countries, minimal data errors and minimal duplications. Many researchers use Thomson Datastream (TDS) for its coverage in terms of number of markets and number of securities in each market.

Ince and Porter (2006), however, document important issues of coverage, classification, and data integrity and find that naive use of TDS data can have a large impact on economic inferences. But they also show that after careful screening of the TDS data, inferences drawn from TDS data are similar to those drawn from CRSP. Based on the filters developed using US TDS data, they provide guidelines for screening international TDS data. The screens we apply to the international TDS data are similar to the guidelines proposed in Ince and Porter (2006) and we go even further for some issues as summarized below.

We use 20 years (from Jan. 1980 till Dec. 1999) of end-of-period monthly dollar returns from TDS for common stocks. On the basis of data availability and coverage within and across regions, we select the following countries: North America (Canada, United States), Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru), Japan, Asia-ex-Japan (China, Hong Kong, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand), Euro-in countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain), Euro-out countries (Denmark, Greece, Norway, Sweden, UK), Switzerland, Australasia (Australia, New Zealand) and South-Africa. We extract the data from the TDS Research and Dead lists for each country. We screen for undesired assets and data errors. More specifically we delete dual listings within and across exchanges (e.g. ADRs, GDRs, identical shares), preferred shares, warrants, certificates, shares from the same company but with different voting rights, error shares (e.g. shares with no name, one-day shares), shares that duplicate information on individual companies (e.g. funds, trusts, investment companies, financial holding companies). We next apply screens that eliminate small, illiquid and penny stocks. Penny stocks have a larger probability to contain errors. They are often fallen stocks which are highly speculative and illiquid. Small companies also have limited liquidity, can be subject to high price pressure or price manipulation, and often represent too little value to warrant attention. In practice this means that an end-of-month price formation of a stock with a market capitalization smaller than $10,000,000 or a monthly trading volume smaller than $100,000 or a price smaller than $1, are eliminated. Whenever trading volume information is not available, we consider an unchanged monthly price (in local currency) as a sign of low trading volume and unreliable price formation for that month and hence both returns based on this price are eliminated. Lastly, we eliminate all stock quotes corresponding to a negative book-to-market value. After applying these automated screens we manually screen for high-return errors. TDS contains some returns that are simply too good to be true and can be very influential for regression results. The few high-return errors that slipped through the automated filters are: (1) decimal-sign shifting; (2) anomalously low first price of a series (probably theoretical or illiquid); (3) high reported return not mirroring a similar change in TDS's reported market capitalization or price, and not corresponding to a huge dividend payout; (4) data reported before actual introduction date or after the actual delisting date; (5) obvious typos; (6) wrongly handled equity offerings. All these are treated as missing observations.

2 Small Firms: Expected Effects in a HR Variance Analysis

Since the discussion assumes some knowledge of the HR methodology, we start with a brief review. We then document the characteristics of small firms that could affect the country-*v*-sector balance.

2.1 Purpose and interpretation of the HR factors

We refer to individual assets by a code $j = 1, ..., N$. Affiliated with this code list there is a country-code list K whose element $K(j)$ equals the country code for stock j, and a sector-code list I whose element $I(j)$ equals the sector or industry code for stock j. The return of the stock is generated by four factors: the world factor ω; the factor of the stock's country, $\kappa_{K(j),t}$; the factor of the stock's sector, $\iota_{I(j),t}$; and a purely idiosyncratic factor, $\epsilon_{j,t}$:

$$\tilde{r}_{j,t} = \omega_t + \kappa_{K(j),t} + \iota_{I(j),t} + \epsilon_{j,t}. \tag{2.1}$$

The country factors have a weighted mean of zero across countries, and likewise for the industry factors. (We return to the issue of weighting schemes later.) In practice, this analysis-of-variance type model is estimated by cross-sectional regressions, one per period t, with a constant and two full sets of dummies indicating j's country or industry affiliation, and with the constraint that the weighted average country or industry effect be zero each period. For simplicity of notation we drop the time subscripts. The weight for a country k or a sector s is denoted as w^c_k and w^s_i, respectively, and the indicator for the event that stock j belongs to country k or sector i is denoted by $\mathbf{1}_{k=K(j)}$ or $\mathbf{1}_{i=I(j)}$. Thus,

$$\begin{aligned}
\tilde{r}_j &= \omega + \sum_k \kappa_k \mathbf{1}_{k=K(j)} + \sum_i \iota_i \mathbf{1}_{i=I(j)} + \epsilon_j, && (2.2)\\
&\text{s.t. } \sum_k w^c_k \kappa_k = 0 = \sum_i w^s_i \iota_i. && (2.3)
\end{aligned}$$

These cross-sectional regressions are run every period, thus generating a time series of world, country and industry factors needed for the analysis.

Let us define w_j to be a set of weights for the stocks in the world market factor. This could be equally weighted, or value weighted, or perhaps even a scheme that gives all sector×country portfolios an equal weight in the total world factor. We further denote weights for sub-aggregates and sub-index returns as follows:

$$\begin{aligned}
w^{sc}_{i,k} &= \frac{\sum_j w_j \mathbf{1}_{i=I(j)} \mathbf{1}_{k=K(j)}}{\sum_j w_j \mathbf{1}_{k=K(j)}}, \text{ the weight of sector } i \text{ in the } k\text{-th national market } k,\\
w^{cs}_{k,i} &= \frac{\sum_j w_j \mathbf{1}_{i=I(j)} \mathbf{1}_{k=K(j)}}{\sum_j w_j \mathbf{1}_{i=I(j)}}, \text{ the weight of country } k \text{ in the } i\text{-th sectoral index},\\
w^c_k &= \sum_j w_j \mathbf{1}_{k=K(j)}, \text{ the weight of country } k \text{ in the world index},\\
w^s_i &= \sum_j w_j \mathbf{1}_{i=I(j)}, \text{ the weight of sector } i \text{ in the world index},\\
r^c_k &= \frac{\sum_j w_j \mathbf{1}_{k=K(j)} r_j}{\sum_j w_j \mathbf{1}_{k=K(j)}}, \text{ the weighted average return of stocks from country } k, \quad (2.4)\\
r^s_i &= \frac{\sum_j w_j \mathbf{1}_{i=I(j)} r_j}{\sum_j w_j \mathbf{1}_{i=I(j)}}, \text{ the weighted average return of stocks from sector } i.
\end{aligned}$$

To interpret the country factor, we start from the standard definition of the country's market-index return, Equation (2.4), and substitute the HR Equation (2.1), taking into account that all stocks are from the same country. We next take the constants out of the averaging operation and also use the feature that, because of the country dummy, in each national subsample the residuals sum to zero. In the last line but one we use the constraint $\sum_i w_i^s \iota_i = 0$ so as to facilitate interpretation:

$$
\begin{aligned}
r_k^c &= \frac{\sum_j w_j \mathbf{1}_{k=K(j)} \left(\omega + \kappa_k + \sum_i \iota_i \mathbf{1}_{i=I(j)} + \epsilon_j\right)}{\sum_j w_j \mathbf{1}_{k=K(j)}}, \\
&= \omega + \kappa_k + \sum_i \iota_i \frac{\sum_j \mathbf{1}_{i=I(j)} \mathbf{1}_{k=K(j)}}{\sum_j w_j \mathbf{1}_{k=K(j)}}, \\
&= \omega + \kappa_k + \sum_i \iota_i w_{i,k}^{sc}, \\
&= \omega + \kappa_k + \sum_i \iota_i (w_{i,k}^{sc} - w_i^s); \\
\Rightarrow \kappa_k &= \underbrace{(r_k^c - \omega)}_{\text{excess country return}} - \underbrace{\sum_i (w_{i,k}^{sc} - w_i^s)\iota_i}_{\text{sector imbalance effect}} .
\end{aligned}
\tag{2.5}
$$

Thus, the country factor implicitly starts from the standard country-index return in excess of the world return ω, and corrects this for industry factors if and to the extent that the country's industry weights w^{sc} differ from the global sector weights w^s as used in the world-market factor. In the remainder of this article, the standard country-index return in excess of the world-market return is referred to as the excess country return, and the correction for deviations of the country's sector weights from the global sector weights is referred to as the sector imbalance effect.

A similar result holds for the industry factors:

$$
\iota_i = \underbrace{(r_i^s - \omega)}_{\text{excess industry return}} - \underbrace{\sum_k (w_{k,i}^{cs} - w_k^c)\kappa_k}_{\text{country imbalance effect}} . \tag{2.6}
$$

Heston and Rouwenhorst (1994) use individual stock returns as left-hand-side variables. For reasons explained below we work, instead, with portfolios that contain stocks sorted two-dimensionally, i.e. by both nationality and sector. The construction of the portfolios matches the weighting scheme w^c and w^i in the constraints (2.3) and the weights in the cross-sectional Weighted Least Squares (WLS) regressions. One approach is to weight each stock equally in the left-hand-side portfolios; if w^c and w^i are then set equal to the number of shares in the country or sector and the regressions use WLS with weights equal to the number of shares in the regressand portfolio, then the factors ω, κ_k and ι_i are all equally weighted across all shares. That is, each country or sector factor has an impact on the world market factor proportional to the number of shares in that country or sector; and each (k, i) intersection portfolio has an impact on the corresponding country or sector factor proportional to the number of shares in that (k, i) intersection portfolio. Alternatively, one can adopt value weights in the (k, i) intersection portfolio; the matching WLS weighting scheme then is to use the market capitalizations of the left-hand-side portfolios, and the matching scheme in the constraints is to set w^c and w^i equal to the market capitalization in the country and sector. Then ω, κ_k and ι_i are value-weighted across all shares. Lastly, one can also apply Ordinary Least Squares (OLS) and use equal weights w^c and w^i; then ω, κ_k and ι_i are equally weighted across all domestic sector portfolios regardless of how many stocks or how much market cap is included in the index.

2.2 Return Characteristics of Small Stocks

In this section we document three relevant properties of small stocks that affect the country-*v*-industry variance ratio: (*i*) they exhibit more variability of return; (*ii*) their sensitivity to global sector effects is weaker than is the case for large-cap companies; and (*iii*) their sensitivity to local market effects is weaker than is the case for large-cap companies.

2.2.1 Fact 1: Small-cap stocks are more volatile than large-cap stocks

It seems intuitively obvious that small-cap stocks have more variability than large-caps. In a first attempt to verify this empirically we rank all individual stocks of a given country—both OECD and emerging—on the basis of average market cap for 1980-1999. For each of the country's 20% smallest stocks we compute the standard deviation of the monthly dollar return of all individual stocks for the period 1980-1999, and likewise for the country's 20% largest firms. We lastly compute for every country the difference between the average small-cap and the average large-cap standard deviation. The results of these prima facie tests, shown at the bottom of Table 1, are unexpected: there seems to be no difference. The average big-cap standard deviation is actually larger than the average small-cap one, albeit by about 19bp only (against an average of 13.19%); the median points in the other direction; and, in a simple count we find that, out of 39 countries, in only 21 is the average standard deviation for small-cap stock returns larger then the average standard deviation of its large-cap section.

But the size distribution may differ a lot across countries and sectors: one country's big-caps may be small by another's standards, for instance, or one country's dwarfs could be predominantly from one industry. To get a clearer view on such effects we cross-sectionally

Table 1: **Small- and Large-caps Compared: Simple Average Volatility**

average standard deviation for big v. small firms, per country

	big	small	diff.		big	small	diff.
Argentina	14.98	15.18	–0.20	Luxemburg	8.30	8.05	0.25
Australia	9.39	11.86	–2.47	Mexico	12.66	10.22	2.44
Germany	11.80	12.26	–0.46	Malaysia	13.54	18.79	–5.25
Belgium	9.78	8.30	1.48	Netherlands	10.50	10.74	–0.24
Brazil	24.58	18.51	6.07	Norway	13.64	14.06	–0.42
Colombia	11.75	10.93	0.82	New Zealand	10.91	8.36	2.55
China	14.13	14.32	–0.19	Austria	10.37	9.97	0.40
Chili	10.58	9.97	0.61	Peru	23.01	13.53	9.48
Canada	12.54	15.64	–3.10	Philippines	12.66	13.43	–0.77
Denmark	10.15	7.20	2.95	Portugal	10.47	14.23	–3.76
Spain	12.24	12.15	0.09	South Africa	12.65	12.35	0.30
Finland	14.14	14.25	–0.11	Sweden	10.68	12.73	–2.05
France	10.70	12.78	–2.08	Singapore	11.80	10.14	1.66
Greece	23.52	24.90	–1.38	Switzerland	8.64	9.56	–0.92
Hong Kong	18.90	12.54	6.36	Taiwan	15.57	12.69	2.88
Indonesia	13.04	14.12	–1.08	Thailand	14.69	13.40	1.29
India	16.38	19.63	–3.25	U.K.	11.03	11.89	–0.86
Ireland	10.52	9.81	0.71	U.S.	14.30	15.74	–1.44
Italy	10.66	12.08	–1.42				
Japan	11.61	14.62	–3.01	**overall average**	13.28	13.09	0.19
Korea	21.19	19.39	1.80	**overall median**	12.24	12.69	–0.43

Key The table shows the average standard deviation for large- and small-caps, respectively, defined as the country's top and bottom 20 percent.

regress the estimated standard deviations of all individual stocks in the top or bottom quintile on three sets of dummies: two size indicators, subscripted as $s = bg$ (big) or $s = sm$ (small); 39 country dummies; and 34 level-4 sector ones:

$$\begin{aligned}\sigma_j &= a + \sum_{s=\{bg,sm\}} b_s \mathbf{1}_{S(j)=s} + \sum_{k=1}^{39} c_k \mathbf{1}_{K(j)=k} + \sum_{i=1}^{34} d_i \mathbf{1}_{I(j)=i} + \epsilon_j, \\ &\text{s.t.} \sum_{s=\{bg,sm\}} b_s = \sum_{k=1}^{39} c_k = \sum_{i=1}^{34} d_i = 0. \end{aligned} \tag{2.7}$$

where σ_j is the standard deviation of the returns from stock j and where $S(j)$, $K(j)$ and $I(j)$ indicate, respectively, the size-class, country, and sector code associated with j: $S(j)=$ bg or sm; $K(j)$=1 to 39; $I(j)$ =1 to 34. The resulting size effect, $b_{bg} - b_{sm}$, along with its White-corrected t-statistic is shown in the rightmost part of line 1 of Table 2. Controlling for both country and sector, the difference between big- and small-caps within a given country re stock variability now has the intuitively expected negative sign: small-cap firms are more volatile, taking into account country and sector affiliation. The difference is statistically very significant (t=11.89) and large (–1.14 percent per month rather than +0.19). But note that the fact that we need to control for countries and sectors before we find a size effect means that size is not randomly distributed across countries and industries.

The next step in the argument is that these small stocks also have weaker global-sector exposure, that is, that the extra volatility has local or idiosyncratic roots.

2.2.2 Fact 2: Small stocks have weaker global-sector affinities

To see whether small-caps are less sensitive to their global sector index than are large-caps, we adopt a two-step procedure. First, all individual stocks are grouped into portfolios based on the intersection of their country (39 of them), level-4 sector (34) and size category (2). This generates potentially 2×34×39=2652 portfolios, of which 1400 are effectively available. We compute, for each of these intersection portfolios p, the equally weighted monthly dollar return r_p for the period 1980-1999, and regress it on the appropriate global-sector index return $r^s_{I(p)}$:

$$r_{p,t} = \alpha_p + \beta_p r^s_{I(p),t} + \eta_{p,t}. \tag{2.8}$$

The result is a cross-section of sector exposure estimates β_p, their t-statistics and the sector model's R^2s.

In an exploratory simple test we compute the simple average of the big-stock sector β_ps versus small-stock sector β_ps, and likewise for the t-statistics and the R^2s. The averages are shown in Table 2, in lines 2-4 of the "simple average" panel. The average sector beta for big firms is meaningfully larger than that of small firms (0.65 versus 0.37), t-statistics are systematically larger, and so are, therefore, the R^2s. Although this tentatively indicates already that small-caps are less exposed to their sector index, we prefer to check for country and sector effects. Thus, in the second step, we regress a measure of sector affinity, X_p, on three sets of dummies (two size, 34 country and 39 sector ones):

$$\begin{aligned} X_p &= a + \sum_{s=\{bg,sm\}} b_s \mathbf{1}_{S(p)=s} + \sum_{k=1}^{39} c_k \mathbf{1}_{K(p)=k} + \sum_{i=1}^{34} d_i \mathbf{1}_{I(p)=i} + \epsilon_p, \\ &\text{s.t.} \sum_{s=\{bg,sm\}} b_s = \sum_{k=1}^{39} c_k = \sum_{i=1}^{34} d_i = 0. \end{aligned} \tag{2.9}$$

The measure of sector sensitivity, X_p, is either the exposure itself (β_p), or its t-statistic, or the regression's R^2. The estimates of the size effect are provided in Table 2, in the rightmost panel, lines 2-4. Recall that, in Table 2, for each measure of global-sector affinity there already is a substantial difference between small-caps and large-caps if we look at simple averages,

Table 2: **Small- *v* Large-caps: Volatility and Affinity to Industry or Country**

		simple averages			*cet. par.* size effect, ($b_{bg} - b_{sm}$)	
		(a) big	(b) small	(a)-(b)	coeff	t-stat
fact 1—volatility	σ_p (% p.m.)	13.28	13.09	+0.19	+1.14	+11.89
fact 2—sector affinity	β_p	0.65	0.37	+0.28	+0.28	11.40
	$t(\beta_p)$	5.26	1.61	+3.65	+3.76	42.31
	R^2	0.17	0.09	+0.08	+0.10	23.15
fact 3—country affinity	δ_p	0.91	0.65	+0.26	+0.27	8.03
	$t(\delta_p)$	11.59	3.67	+7.93	+8.03	57.18
	R^2	0.45	0.20	+0.25	+0.25	49.55

Key *Line 1*: In each country we take the 20% biggest and the 20% smallest stocks, and compute the average volatility in percent per month for each group. The first part of the line shows the averages across countries, and their difference. The second part of the first line shows a big–small effect from an analysis-of-variance regression of 1400 size$\times(k,i)$ intersection portfolio sigmas, with, as right-side variables, 2 size, 39 country and 34 sector dummies.
Lines 2-4: The inputs for the computations are obtained from 1400 regressions of size$\times(k,i)$ intersection portfolio returns on their own global sector index return r^s. From these regressions we here analyse three statistics: the sector exposure estimates, their t-statistics, and the model R-squares. We first compare simple averages, big versus small. The second part of each line shows a big–small effect from an analysis-of-variance regression of the 1400 statistics with, as right-side variables, 2 size, 39 country and 34 sector dummies.
Lines 5-7: The inputs for the computations are obtained from 1400 regressions of size$\times(k,i)$ intersection portfolio returns on their own country index return r^c. From these regressions we here analyse three statistics: the country exposure estimates, their t-statistics, and the model R-squares. We first compare simple averages, big versus small. The second part of each line shows a big–small effect from an analysis-of-variance regression of the 1400 statistics with, as right-side variables, 2 size, 39 country and 34 sector dummies.

without any fussing about country and sector effects. These differences are unaffected if we take into account those characteristics too. Thus, controlling for country and sector affiliation, big-caps are significantly more exposed to their sector index ($\overline{\beta} = 0.62$) [3] than are small-caps (0.34); the difference, 0.28, was already present in the unconditional means too. Relatedly, the big stocks' typical t-statistics for the sector exposure are 3.76 apart, with the small-cap t around 0.83 versus around 4.59 for large-caps. The average R^2, lastly, drops from 0.17 (large-cap) to 0.07 (small-cap)—a slightly larger fall than the change in the unconditional means, 0.08.

In light of the above, adding small firms into the database should have a dampening effect on sector-generated variability in stock returns: if the firms added into the global sector indices have only a weak correlation with what goes on at the global sector level, the diversification

[3] The mean conditional exposure numbers, t's, and R^2s are not shown. Full details are available on request.

effect in the HR factors should overcome the (high) own-variance effect.[4] In Section 3 we check how important the effect is; first we still need to study the comparative behavior of small stocks as far as country sensitivity is concerned.

2.2.3 Fact 3: Small stocks have weaker country-index affinities

We proceed as we did for sector sensitivity. That is, we again take the returns time series from each of the 1400 portfolios based on the intersection of their country (39 of them), level-4 sector (34) and size category (2), and regress it on the appropriate country-index return $r^c_{K(p)}$:

$$r_{p,t} = \gamma_p + \delta_p r^c_{K(p),t} + \zeta_{p,t}. \tag{2.10}$$

The result is a cross-section of country exposure estimates δ_p, their t-statistics and the country model's R^2s. Simple averages are reported in lines 5-7 of Table 2, alongside the differences and their t-statistices after controlling for country and sector effects.

Recall that, in the literature, a high sensitivity to the own-country return is often associated with small stocks, possibly via the lack of media attention or analyst following, two elements that affect the availability of and reaction to firm-specific news. Still, in our sample we find the inverse. Big stocks have betas close to unity rather than the 0.65 we see for small firms; their t-statistics are about 8 higher, and the local-market-model R^2 is 0.45 rather than 0.20. Note, in passing, that country sensitivities are systematically higher than sector sensitivities, whether we consider the exposures, or their t's, or the R^2's.

In light of the above, adding small firms into the database should again have a dampening effect on country-generated variability in stock returns: the firms added into the country indices have only a weak correlation with what goes on locally, so despite the high volatility a diversification effect should occur. This is the inverse of what we had expected at the onset. We now turn to the HR procedure to gauge how strong all these effects are, and which dominates.

3 Results for a HR Variance Analysis

3.1 Base Case: no small firms, no emerging markets

[4] Recall that the marginal contribution of an asset to a portfolio's variance is the asset's covariance with the entire portfolio, in which the covariances with the hundreds of other assets dominate.

Table 3: **Country and sector factors from the base-case sample**

$$\tilde{r}_j = \omega + \sum_k \kappa_k \mathbf{1}_{k=K(j)} + \sum_i \iota_i \mathbf{1}_{i=I(j)} + \epsilon_j, \text{s.t. } \sum_k w_k^c \kappa_k = 0 = \sum_i w_i^s \iota_i.$$

Panel A: country factors

	$\text{var}(\kappa)$	$\frac{\text{var}(\kappa)}{\text{var}(r_k^c-\omega)}$	$\text{var}\left(\sum_i w_{i,k}^{sc}\iota_i\right)$	$\frac{\text{var}\left(\sum_i w_{i,k}^{sc}\iota_i\right)}{\text{var}(r_k^c-\omega)}$
Australia	18.47	100.03%	0.84	4.52%
Germany	15.97	94.24%	0.16	0.96%
Belgium	12.26	93.04%	0.13	0.96%
Canada	14.87	92.60%	1.68	10.44%
Denmark	13.95	95.63%	0.27	1.87%
Spain	20.29	96.78%	1.04	4.96%
Finland	40.74	99.55%	0.14	0.35%
France	14.56	98.36%	0.03	0.22%
Greece	154.08	101.26%	0.33	0.21%
Ireland	15.01	98.63%	0.56	3.68%
Italy	37.98	104.90%	1.03	2.84%
Japan	48.38	99.48%	0.15	0.30%
Netherlands	14.57	105.62%	0.13	0.95%
Norway	32.34	95.56%	0.29	0.84%
New Zealand	31.00	98.82%	0.53	1.70%
Austria	26.72	94.48%	0.28	0.97%
Portugal	23.70	98.48%	0.49	2.05%
Sweden	28.17	97.01%	0.15	0.53%
Switzerland	12.09	93.00%	0.29	2.22%
U.K.	12.10	102.95%	0.05	0.41%
U.S.	9.16	97.56%	0.05	0.52%
Cross-country average	28.40	98.00%	0.41	1.98%
Median	18.47	97.56%	0.28	1.96%

Panel B: sector factors

	$\text{var}(\iota)$	$\frac{\text{var}(\iota)}{\text{var}(r_i^s-\omega)}$	$\text{var}\left(\sum_i w_{k,i}^{cs}\kappa\right)$	$\frac{\text{var}\left(\sum_k w_{k,i}^{cs}\kappa_k\right)}{\text{var}(r_i^s-\omega)}$
Basic Industries	2.09	40.33%	2.27	43.73%
Cyclical Consumer Good	2.10	83.02%	0.68	26.90%
Cyclical Services	1.10	103.73%	0.17	16.28%
General Industries	1.35	90.51%	0.43	28.76%
Information Technology	17.97	82.10%	1.19	5.43%
Non-cyclical Consumer	3.94	92.00%	0.18	4.14%
Non-cyclical Services	4.75	92.20%	0.54	10.39%
Resources	26.15	99.77%	3.54	13.50%
Financials	7.10	94.96%	0.32	4.34%
Utilities	18.24	107.78%	1.22	7.18%
Cross-sector average	8.48	88.64%	1.05	16.06%
Median	4.34	92.10%	0.61	11.95%

Key The base case considers 21 OECD countries, and within each country we go down the list of cap-ranked stocks until we have picked up 80% of the country's total market capitalization. Equally weighted level-3 (k, i) intersection portfolio returns are calculated for every country for the period 1990-1999. For every month, the cross-sectional regression equation (2.2)-(2.3), reproduced in the caption, is run using WLS with weights equal to the number of stocks generating the (k, i) intersection portfolio at that month. The weighted sum for the country and sector factors is set equal to zero with weights equal to the number of shares in portfolio (k, i). In Panel A we show the average HR country variance $\text{var}(\kappa)$, first separately and then scaled by the variance of the excess country return, $r_k^c - \omega$, ω being the world return. The difference between these two is the sector imbalance effect, $\sum_i w_{i,k}^{sc}\iota_i$. Also the variance of the latter is shown, separately and scaled. Panel B does likewise for the HR industry factor returns ι, the country imbalance effects, and the excess sector returns $r_i^s - \omega$.

As our base-case sample we consider 21 OECD countries and ten level-3 industries. Within each country we adopt a stock selection that omits the smallest stocks. Specifically, we went down the list of average-cap ranked stocks and retained the firms in the top four quintiles by size. Equally weighted (k, i) intersection portfolio returns are calculated for every country for the period 1990-1999. For every month, the cross-sectional regression equation (2.2) is run using WLS with weights equal to the number of stocks composing the intersection portfolio for country k and sector i in that month. In the zero-sum constraint (2.3), similarly, the weights are equal to the number of shares in the (k, i)-th intersection portfolio .

Table 3 summarizes the results. At 28.40 percent per month squared, the typical country-factor variance is more than three times larger than the average sector-factor variance (8.48). Thus, country effects strongly dominate sector effects and probably need to be watched first if a top-down portfolio selection approach is adopted. The HR global-factor variance (16.52) is between the country-factor variance (28.40) and the industry-factor variance (8.48). This again underlines the importance of specific country and sector effects in international stock returns. A second finding is that the ingenious HR corrections for sector imbalances in country returns and *vv* turn out to be relatively minor, like in the original study. Panel A shows that only a small portion—1.98%—of the variance of excess country returns can be traced to sector imbalances. The reason is twofold: first, given that we consider OECD countries and use fairly broad sector definitions, sector weights within each country are never very far from world weights; second, the sector factors themselves have smaller variances, as we just found. This smaller variability also explains why country-imbalance effects in sector-index excess returns have relatively more impact, at 16%.[5]

We complement this discussion of the general picture with a closer look at some individual countries and sectors. From all countries, the country-specific effects of Greece (e.g. local political, economic and financial regimes and decisions) generate the highest variance at 154.08 after taking out the world effect and any sectoral-imbalance effect. In Canada, 10.44% of the countrys volatility is explained by its specific sector-mix. Compared to other countries, Canada seem to be relatively specialized in a few sectors compared to the world portfolio. Among the sectors, after taking out the world effects and any country-imbalance effect the highest variances still occur in the IT, Resources and Utilities sectors. The Basic Industries sector seems to be

[5] From equations (2.5) and (2.6), the variability of the imbalance effects could also be driven by the size of the imbalances, w^c and w^s, rather than the factor variances. It turns out that the imbalances themselves are not very different: $\overline{|w^c|} = 0.16$ and $\overline{|w^s|} = 0.19$, on average.

Table 4: **Robustness of HR results to size and other sampling choices**

Panel A: factor variance ratios

	var(κ)/var(ι)	var(κ)/var(ω)	var(ι)/var(ω)
–base case:	3.35	1.72	0.51
–size coverage: add smallest 20%	3.53	1.73	0.49
–country coverage:			
–add emerging markets	7.58	4.92	0.65
–use only G7	2.62	1.27	0.48
Robustness to other sampling choices			
–time period:			
–1980-89	4.50	1.61	0.36
–1990-94	2.89	3.87	1.34
–1995-99	2.11	3.12	1.48
–34 (narrower) sectors	2.84	1.80	0.63
–value weighting	3.29	1.76	0.53
–equal weighting of (k, i) indices	5.72	1.60	0.28

Panel B: % weight of sector imbalances in country variance (column (a)) or country imbalances in sector variance (column (b))

	(a) (country)	(b) (sector)	(a)/(b)
–base case:	1.98%	16.06%	8.11
–size coverage: add smallest 20%	1.83%	18.48%	10.10
–country coverage:			
–add emerging markets	2.01%	0.15%	0.07
–use only G7	2.28%	18.77%	8.23
Robustness to other sampling choices			
–time period:			
–1980-89	1.88%	15.62%	8.31
–1990-94	2.45%	8.45%	3.45
–1995-99	3.13%	6.48%	2.07
–34 (narrower) sectors	2.99%	17.85%	5.97
–value weighting	5.57%	16.23%	2.91
–equal weighting of (k, i) indices	0.22%	2.53%	11.50

Key var(κ), var(ι) and var(ω) are the average variances of the country, sector and world factors. The numbers in Panel B, column (a) are the average variance of $\sum_i w_{i,k}^{sc} \iota_i$—the sector imbalance effects in a country—as a fraction of the variance of the excess country return $r_k^c - \omega$; the numbers sub (b) are the counterparts for the sector indices.

most geographically concentrated: 43.73% of the sectors excess-return volatility is explained by its specific geographical distribution.

3.2 Robustness to Size and Country Coverage

We repeat the same calculations except that now also the 20 percent smallest firms are included in the indices. Returns are still equally weighted within each (k, i) intersection portfolio. Recall that the expected effect of expanding the coverage is that both the sector and the country factors become less volatile: there is a diversification effect because small stocks behave more idiosyncratically. Whether, on balance, there still is a net change in the variance ratio, and how large it is, is what we are after now. Table 4 qualitatively shows that the country factor is If, instead of using just the top-80% firms we include all stocks, there is only a small rise in the var(κ)/var(ι) ratio for the all-stock sample (3.53) relative to the base-case sample (3.35). The average country- and sector-specific variance compared to the worldwide variance moves in the originally expected directions, but by minute amounts. In Panel B we pick up a rise in the relative imbalance effect, (a)/(b) in the rightmost column of Panel B, from 8.11 to 10.10. That is, if small stocks are included into the sample, country effects can explain ten times more sector-index volatility than sector effects can explain country-index variance, up from eight. Again the effect is as originally expected but underwhelmingly so.

The effect of country coverage, in contrast, is very marked. This is especially true if we add 15 non-OECD markets to the sample. (We keep using just the large- and mid-caps of each country, so as to minimise any direct size effect, however weak.) In Panel A, var(κ)/var(ω) rises from 1.72 tot 4.92; that is, adding emerging markets to the sample boosts the average country-specific volatility compared to the world-factor volatility. This is consistent with emerging countries being less integrated into the world economy, such that their country index is largely idiosyncratic and country-specific. True, also the sector variances rise somewhat relative to the world-market variance, but far less so—from 0.51 to 0.65 only. The combined result is that the country/industry variance ratio, var(κ)/var(ι), more than doubles.

Since the impact of extending the size coverage, holding constant the country list, is minimal, it is far from obvious that we should ascribe the emerging-market phenomenon to the fact that firms in younger markets tend to be smaller. But nor can one ascribe all of the emerging-market effect to the maturity of financial markets: also the size of the economies matter and the degree of industrial diversity within each country. For example, if instead of widening the sample we narrow down the OECD to the largest economies, the G7, we observe the opposite effects: the average country-specific and sector-specific volatility both go down compared to the world factor volatility, consistent with G7 countries being more diversified, more integrated into the world economy and more similar to each other. Mirroring our results from the widening of the sample, the narrowing of the country coverage affects the country-factor volatility more than the industry-factor volatility: the country/sector variance ratio, var(κ)/var(ι), falls from 3.35 to 2.62. As levels of financial sophistication are not that different between G7 and non-G7 OECD members, the country's size and industrial diversity must have been responsible for most of the effect.

For completeness we briefly review other robustness checks. Over time, the importance of country factors relative to industry factors has fallen, as documented by others, but without dropping anywhere to equality. Interestingly, though, both country and sector factors have risen in prominence relative to world-market risk. So the case for general diversification, across both countries and sectors, seems strengthened. Working with narrower sectors (34 level-4 industries instead of 10 level-3 ones) has the expected effect: there is less diversification within sectors, so there is more industry-related variance. But the effect is small. The weighting schemes, finally, have a similarly weak impact on the variance ratios.

4 Conclusion

In the debate whether country factors are typically more variable than sector factors, sparked off by e.g. Roll (1991) and Heston and Rouwenhorst (1994), one of the few uncontested facts is that the addition of emerging markets (EMs) does boost the ratio of country-factor variance relative to industry-factor variance. Emerging markets do tend to have a higher variability but simultaneously are less related to global market and industry factors. We investigate to what extent this phenomenon can be traced to the impact of adding more small firms. We find, first, that small firms do have higher volatility, but one needs to control for country and sector affiliation before that becomes visible. We next find that small firms do have weaker sector affinity, as expected. Third, small firms unexpectedly have weaker local-market sensitivities than large firms. Facts 2 and 3 mean that adding more small firms to the data base has a diversifying effect on both the sector- and country-factor variance; and while the impact on sector variance is larger, the net effect turns out to be tiny. Fourth, adding emerging markets has a very marked impact on the variance ratio. In fact, the addition of small stocks to the sample hardly dents the effect of adding EMs. Thus, the role of emerging markets cannot be reduced to just a small-firm phenomenon.

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Appendix tables

Table 5: **The strength of the sector affiliation, small- vs. large-caps: country dummies**

	σ_p		β_p		$t(\beta_p)$		(R^2)	
	coef	tstat	coef	tstat	coef	tstat	coef	tstat
Argentina	3.02	3.85	0.38	3.83	1.22	3.37	0.02	1.17
Australia	2.95	7.47	0.09	1.68	0.60	2.93	0.05	5.18
Germany	1.27	5.33	0.14	2.61	0.77	4.01	0.01	1.69
Belgium	4.02	8.55	0.07	1.15	0.06	0.25	0.03	2.86
Brazil	8.67	17.98	0.25	3.58	1.59	6.12	0.01	0.46
Colombia	0.04	0.03	1.29	9.33	2.33	4.59	0.01	0.55
China	0.87	3.49	0.60	9.99	2.98	13.61	0.11	10.84
Chili	1.95	2.57	0.13	1.41	1.22	3.68	0.00	0.22
Canada	0.49	2.39	0.00	0.00	2.07	11.22	0.05	6.13
Denmark	3.74	8.34	0.19	2.70	0.88	3.50	0.03	2.35
Spain	0.32	0.64	0.30	4.10	1.02	3.83	0.04	3.57
Finland	0.24	0.44	0.30	4.35	0.27	1.09	0.03	2.76
France	2.09	9.37	0.02	0.48	1.34	7.26	0.00	0.09
Greece	10.82	25.32	1.11	15.41	3.52	13.33	0.03	2.70
Hong Kong	2.81	4.65	0.03	0.29	0.46	1.44	0.02	1.45
Indonesia	0.75	1.61	0.34	5.08	1.90	7.75	0.02	1.38
India	4.47	15.15	0.49	8.33	3.00	13.81	0.10	10.05
Ireland	3.65	4.66	0.03	0.39	0.02	0.05	0.00	0.33
Italy	1.16	3.02	0.09	1.43	0.85	3.57	0.03	2.45
Japan	0.21	1.23	0.43	8.36	6.49	34.33	0.15	17.87
Korea	7.04	30.45	0.38	6.72	0.43	2.08	0.06	6.64
Luxemburg	4.24	3.25	0.06	0.35	1.65	2.83	0.01	0.54
Mexico	1.81	2.72	0.13	1.52	0.73	2.38	0.01	0.59
Malaysia	3.47	11.17	0.43	7.22	0.61	2.80	0.03	3.18
Netherlands	3.16	7.50	0.01	0.13	1.82	7.82	0.01	1.04
Norway	0.32	0.79	0.08	1.31	0.40	1.66	0.01	1.21
New Zealand	3.16	4.44	0.32	3.75	0.73	2.33	0.00	0.07
Austria	1.99	3.41	0.08	0.91	1.03	3.36	0.06	4.25
Peru	4.41	4.64	0.09	0.90	1.99	5.16	0.07	4.00
Philippines	0.20	0.19	0.70	6.20	0.15	0.37	0.04	2.16
Portugal	0.45	0.73	0.10	1.29	0.72	2.45	0.04	3.00
South Africa	1.39	3.55	0.10	1.59	0.28	1.18	0.01	1.07
Sweden	2.66	7.91	0.09	1.60	0.38	1.75	0.02	1.81
Singapore	2.23	4.21	0.09	1.30	0.28	1.05	0.02	1.39
Switzerland	3.43	8.71	0.05	0.81	1.58	7.03	0.06	5.74
Taiwan	0.02	0.06	0.01	0.08	1.11	4.46	0.06	5.71
Thailand	0.73	2.03	0.01	0.08	1.28	5.35	0.08	7.18
U.K.	2.31	14.11	0.17	3.45	4.08	22.26	0.07	8.96
U.S.	0.68	5.83	0.18	3.63	7.66	42.92	0.17	20.76

Key See next table.

Table 6: **The strength of the sector affiliation, small- vs. large-caps: sector dummies**

	(1)		(2a)		(2b)		(2c)	
	coef	tstat	coef	tstat	coef	tstat	coef	tstat
aerospace & defense	1.00	1.87	0.27	2.63	0.03	0.07	0.01	0.42
automobile & parts	0.43	1.67	0.06	0.90	0.38	1.66	0.00	0.22
banks	3.85	23.93	0.05	0.95	0.16	0.87	0.03	3.86
beverages	2.89	7.41	0.06	0.87	0.15	0.63	0.03	2.63
chemicals	0.88	4.20	0.23	4.04	1.13	5.49	0.02	1.73
construction & materials	0.46	2.46	0.02	0.44	0.93	5.06	0.00	0.44
diversified sector	1.18	4.08	0.15	2.70	0.57	2.83	0.02	2.38
electricity	3.78	11.39	0.28	3.97	1.37	5.36	0.05	4.56
electronics & electrics	1.49	8.16	0.18	3.14	0.91	4.41	0.02	1.69
engineering & machinery	0.12	0.67	0.02	0.31	1.17	5.72	0.02	2.37
food & drug retailers	0.82	2.21	0.03	0.43	1.01	3.84	0.04	3.35
food producers	1.82	8.64	0.05	0.90	0.53	2.80	0.02	2.45
forestry & paper	1.64	4.42	0.01	0.21	0.77	3.44	0.02	1.54
household good, textiles	0.22	1.25	0.15	2.86	0.17	0.91	0.00	0.23
healthcare	1.58	5.97	0.09	1.26	1.48	5.82	0.03	2.81
IT hardware	5.65	23.19	0.05	0.72	0.05	0.19	0.01	0.54
insurance	1.73	5.74	0.21	3.42	0.17	0.72	0.03	2.71
leisure & hotels	0.39	1.73	0.14	2.43	0.95	4.44	0.00	0.15
life assurance	3.30	6.58	0.06	0.55	0.66	1.73	0.02	1.30
media & entertainment	1.37	6.12	0.21	3.52	0.22	0.99	0.02	2.27
mining	3.49	13.29	0.09	1.35	1.43	5.83	0.05	4.16
oil & gas	0.16	0.72	0.15	2.19	1.99	8.06	0.04	3.57
personal care & house	0.64	1.39	0.00	0.04	0.15	0.51	0.02	1.24
pharma & biotech	1.42	5.39	0.03	0.44	0.43	1.90	0.02	1.62
real estate	1.05	4.38	0.01	0.24	0.00	0.00	0.02	1.86
general retailers	1.55	7.42	0.10	1.77	0.60	2.76	0.04	4.38
software & services	10.34	57.22	0.04	0.62	0.40	1.83	0.05	5.46
specialty & other finance	0.75	2.59	0.26	3.71	1.08	4.23	0.02	2.00
steel & other metals	0.82	2.92	0.07	1.31	0.39	1.86	0.03	3.67
support services	1.48	7.03	0.13	2.00	0.27	1.11	0.02	2.24
telecom services	4.49	16.32	0.23	4.07	0.87	4.18	0.03	3.40
tobacco	2.70	3.48	0.17	1.81	1.05	3.01	0.02	1.02
transport	1.12	4.75	0.01	0.26	0.19	0.99	0.03	3.05
other utilities	3.72	10.30	0.05	0.70	1.07	3.85	0.01	1.03

Key Coefficients and t-statistics of four analysis-of-variance regressions with right-side variables: 2 size, 39 country and 34 sector dummies; and left-hand-side variables: (1) stock standard deviations, (2a) sector exposure estimates, (2b) sector exposure t-statistics, and (2c) sector model R-squares.